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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : H02H 9/04, H04B 15/00 — A1

(11) International Publication Number: WO 98/54813

(43) International Publication Date: 3 December 1998 (03.12.98)

(21) International Application Number: PCT/AU98/00405

(22) International Filing Date: 29 May 1998 (29.05.98)

(30) Priority Data:
PO 7116 30 May 1997 (30.05.97) AU

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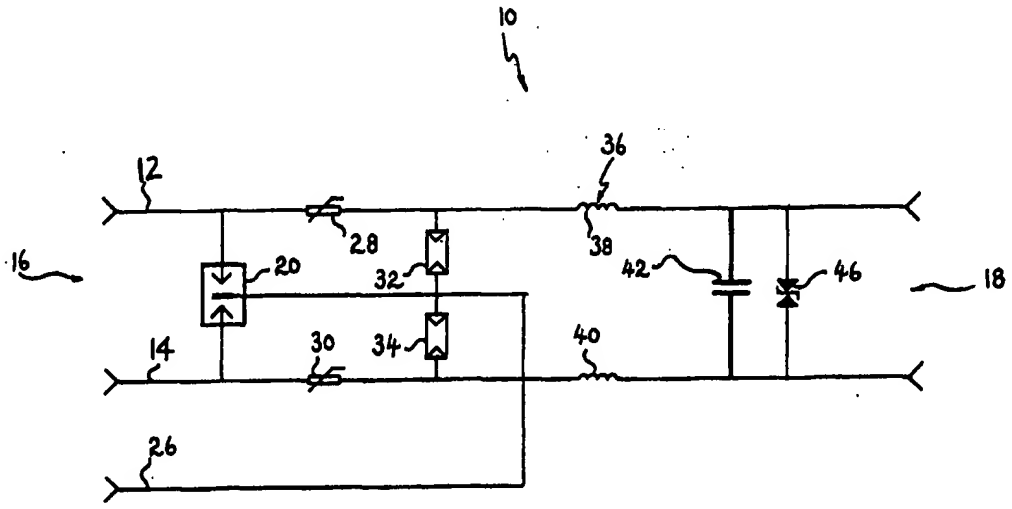
(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, GW, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.

(54) Title: FILTER FOR A PAIR OF DATA COMMUNICATION LINES



(57) Abstract

A filter (10) for a pair of data communication lines (12, 14), said filter (10) having an input (16) for connection to said data communication lines (12, 14) and an output (18) for connection to a communication device such as a modem or facsimile machine, the filter (10) comprising: a gas arrester (20) arranged to absorb voltage transients from said data communication lines (12, 14) provided adjacent the input (16); PTC resistors (28, 30) in series in each data communication line (12, 14) after said first suppression means (20); varistors (32, 34) provided after the PTC resistors (28, 30); an RF filter (36) after the varistors; and transient suppression diodes (46) provided after the RF filter (36).

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TITLE

"Filter for a Pair of Data Communication Lines"

FIELD OF THE INVENTION

The present invention relates to a filter for filtering data communication lines.

BACKGROUND ART

Power line filters have been used to filter voltage surges from power lines. Examples of such line filters are disclosed in US patents 4,023,071 and 4,616,286. Both of these documents disclose power line filters that are designed to suppress high voltage transients in power lines. In each case, the line filter is disposed in parallel between two power lines.

Line filters similar to those disclosed in US patents 4,023,071 and 4,616,286 have been used on telephone lines to suppress high voltages and prevent damage to a telephone or a person using a telephone.

Recently, data communications technology has developed rapidly, with computer modems having considerably increased bits-per-second rates. Bits-per-second rates of 33,600 bits-per-second are common, and 57.6k bits-per-second modems are becoming increasingly popular.

The high bits-per-second throughput of such modems are placing increasingly stringent requirements on the acceptable noise levels in the data communication lines. In many instances, such high speed modems effectively communicate at a reduced throughput speed because of noise and interference on the data communication line.

Line filters previously used for power lines are applicable in preventing damage to the modem from high voltage surges, however, such devices do not assist is maximising the throughput of these high speed modems.

In addition to high voltages, high currents create distortion and jitter in the receiving circuits of a modem which can also act to decrease the effective communication speed. In addition, radio frequency (RF) noise can also have a detrimental effect on the communications speed of a modem.

The power line filters of the prior art are provided in parallel with the power lines and consequently are not readily adapted to filter RF noise and/or high currents from the data communications lines.

SUMMARY OF THE INVENTION

In accordance with one aspect of this invention, there is provided a filter for a pair of data communication lines, said filter having an input for connection to said data communication lines and an output for connection to a communication device such as a modem or facsimile machine, the filter comprising:

first suppression means arranged to absorb voltage transients from said data communications lines provided adjacent the input;

current limiting means provided in series in each data communication line after said first suppression means;

RF filter means including an energy storage device provided after the current limiting means; and

second suppression means arranged to absorb voltage transients from said data communications lines provided after said RF filter means;

said second suppression means having a faster response time than the first suppression means.

Preferably, said filter further comprising further suppression means provided after the current limiting means and before the RF filter means, said further suppression means having a response time intermediate that of the first and second suppression means.

Preferably, the further suppression means comprises two varistors, one extending between each data communication line and an electrical earth.

Preferably, said second suppression means comprises a transient suppression diode.

Preferably, said transient suppression diode is provided between the data communication lines.

Preferably, said current limiting means comprises a PCT resistor provided in series in each data communications line.

Preferably, said first suppression means comprises a gas arrester.

Preferably, said gas arrester extends between each data communications line and an electrical ground.

Preferably, said energy storage device comprises at least one of an inductor and a capacitor.

Preferably, said RF filter means comprises an inductor provided in series in each data communications line and a capacitor provided between the data communications lines.

BRIEF DESCRIPTION OF THE DRAWINGS

An embodiment of the present invention will now be described by way of example, with reference to the accompanying drawing in which:

Figure 1 is a circuit drawing of the embodiment.

DETAILED DESCRIPTION OF THE EMBODIMENT

The embodiment is directed towards a filter 10 for a pair of data communication lines 12, 14 which are to be used for facsimile or data modem communications.

The line filter 10 is provided in series with the data communication lines 12 and 14. The filter 10 has an input 16 and an output 18.

The filter 10 comprises: first suppression means in the form of a gas arrester 20; current limiting means in the form of PTC (positive temperature coefficient) resistors 28 and 30; an RF filter 36 comprising inductors 38 and 40 and a capacitor 42; second suppression means in the form of a transient suppression diode 46; and further suppression means in the form of varistors 22 and 24.

The gas arrester 20 is provided at the input 16 of the line filter 10 between the lines 22 and 24. The gas arrester 20 is also connected to earth via a wire 26.

The PTC resistors 28 and 30 are provided in series in the lines 22 and 24 respectively and are positioned after the gas arrester 20.

The varistor 32 extends between the line 22 and earth via the wire 26. The varistor 34 extends between the line 24 and earth via the wire 26. The varistors 32 and 34 are positioned after the PTC resistors 28 and 30, respectively.

The inductors 38 and 40 are provided in series in the lines 22 and 24, respectively, after the varistors 32 and 34. The capacitor 42 extends between

the lines 22 and 24 and is positioned after the inductors 38 and 40. In effect, the inductors 38 and 40 and the capacitor 42 act as a low pass filter on signals present in the lines 22 and 24.

The transient suppressing diode 46 extends between the lines 22 and 24 and is provided after and in parallel with the capacitor 42.

In use, the filter 10 is positioned between the lines 22 and 24 and a device using the lines, such as a facsimile machine or data modem. The input 16 of the filter 10 is connected to the lines 22 and 24 and the output 18 is connected to the device.

Under normal operating conditions the signal travelling along the lines 22 and 24 is of relatively small voltage and current and has a relatively low frequency. Consequently, such a signal will not activate the gas arrester 20, the varistors 32 and 34 or the transient suppressing diode 46. Further, the signal will pass through the filter 36 without substantial attenuation because of its relatively low frequency.

Similarly, the small voltage and current of such a signal will dissipate little energy in the PTC resistors 28 and 30. The resistance of the PTC resistors 28 and 30 will therefore remain low and not attenuate the signal significantly.

Current surges in the lines 12 and 14 will be suppressed by the PTC resistors 28 and 30. The increasing current will dissipate more energy in the PTC resistors 28 and 30, as a result of which the temperature and consequently the resistance of the PTC resistors 28 and 30 will increase. In turn, this acts to lower the current flowing through the resistors 28 and 30. In this manner, the filter 10 assists in reducing errors in data communication caused by current surges.

Radio frequency noise has a relatively high frequency, and consequently will be filtered by the low pass filter 36. Hence the filter 10 suppresses radio frequency noise and consequently helps reduce the error rate in communication.

High voltage surges can be very damaging to facsimile machines and data modems, which often do not have adequate surge prevention circuitry. If the voltage in the lines 22 and 24 exceeds the activation voltage of the transient suppressing diode 46, which is preferably above the voltage levels typically present in the telephone line, the transient suppressing diode 46 will activate and draw some of the power from the lines 22 and 24, thereby preventing it from damaging a device attached to the output 18. Transient suppressing diodes are typically limited in the power they can draw before being damaged, however they have a relatively fast response time and a low activation voltage compared to a gas arrester. In this regard, placing the transient suppression diode 46 after the filter 36 is advantageous, since the inductors 38 and 40 and the capacitor 42 will store some of the power in the lines 22 and 24, thereby reducing the power that would be absorbed by the transient suppressing diode 46 during the voltage transient. After the voltage transient ends, the energy stored in the inductors 38 and 40 and the capacitor 42 will be released and absorbed by the transient suppressing diode 46.

As the voltage in the lines 22 and 24 continues to rise, the varistors 32 and 34 will activate, drawing still more power from the lines 22 and 24. As power is drawn from the lines 22 and 24 by the varistors 32 and 34, power is also dissipated in the PCT resistors 28 and 30. As power is dissipated in the PCT resistors 28 and 30, their positive temperature co-efficient causes their resistance to increase. The PCT resistors 28 and 30 act to dissipate excess power from the lines 22 and 24 respectively and also provide protection for the varistors 32 and 34 from overloading.

As the voltage in the lines 22 and 24 continues to rise further, the activation voltage of the gas arrester 20 will be exceeded and the gas arrester 20 will

activate. Once activated the gas arrester 20 effectively acts as a short circuit between the lines 22 and 24 and earth, preventing the high voltage transient from reaching the device attached to the output 18. The gas arrester 20 has a high power capacity, allowing it to draw high voltages without damage.

For the purposes of comparison, the response time of a transient suppression diode 46 is typically in the region of 1ps, for a varistor the response time is typically 1μs, and for a gas arrester the response time is typically 1ms or so. The use of a three-stage activation for suppressing voltage transients allows a fast response time whilst avoiding damage to the suppression devices used. Placing the transient suppression diode 46 after the filter 36 provides additional protection for the diode 46 because of the power storage properties of the inductors 38 and 40 and the capacitor 42, as described above.

Thus, the filter 10 of the embodiment provides protection against voltage surges and assists in increasing the data communication rate by filtering RF noise and limiting current surges.

CLAIMS

1. A filter for a pair of data communication lines, said filter having an input for connection to said data communication lines and an output for connection to a communication device such as a modem or facsimile machine, the filter comprising:

first suppression means arranged to absorb voltage transients from said data communications lines provided adjacent the input;

current limiting means provided in series in each data communication line after said first suppression means;

RF filter means including an energy storage device provided after the current limiting means; and

second suppression means arranged to absorb voltage transients from said data communications lines provided after said RF filter means;

said second suppression means having a faster response time than the first suppression means.

2. A filter as claimed in claim 1, further comprising further suppression means provided after the current limiting means and before the RF filter means, said further suppression means having a response time intermediate that of the first and second suppression means.

3. A filter as claimed in claim 1 or 2, wherein the further suppression means comprises two varistors, one extending between each data communication line and an electrical earth.

4. A filter as claimed in any one of the preceding claims, wherein said second suppression means comprises a transient suppression diode.

5. A filter as claimed in claim 4, wherein said transient suppression diode is provided between the data communication lines.

6. A filter as claimed in any one of the preceding claims, wherein said current limiting means comprises a PCT resistor provided in series in each data communications line.

7. A filter as claimed in any one of the preceding claims, wherein said first suppression means comprises a gas arrester.

8. A filter as claimed in claim 7, wherein said gas arrester extends between each data communications line and an electrical ground.

9. A filter as claimed in any one of the preceding claims, wherein said energy storage device comprises at least one of an inductor and a capacitor.

10. A filter as claimed in claim 9, wherein said RF filter means comprises an inductor provided in series in each data communications line and a capacitor provided between the data communications lines.

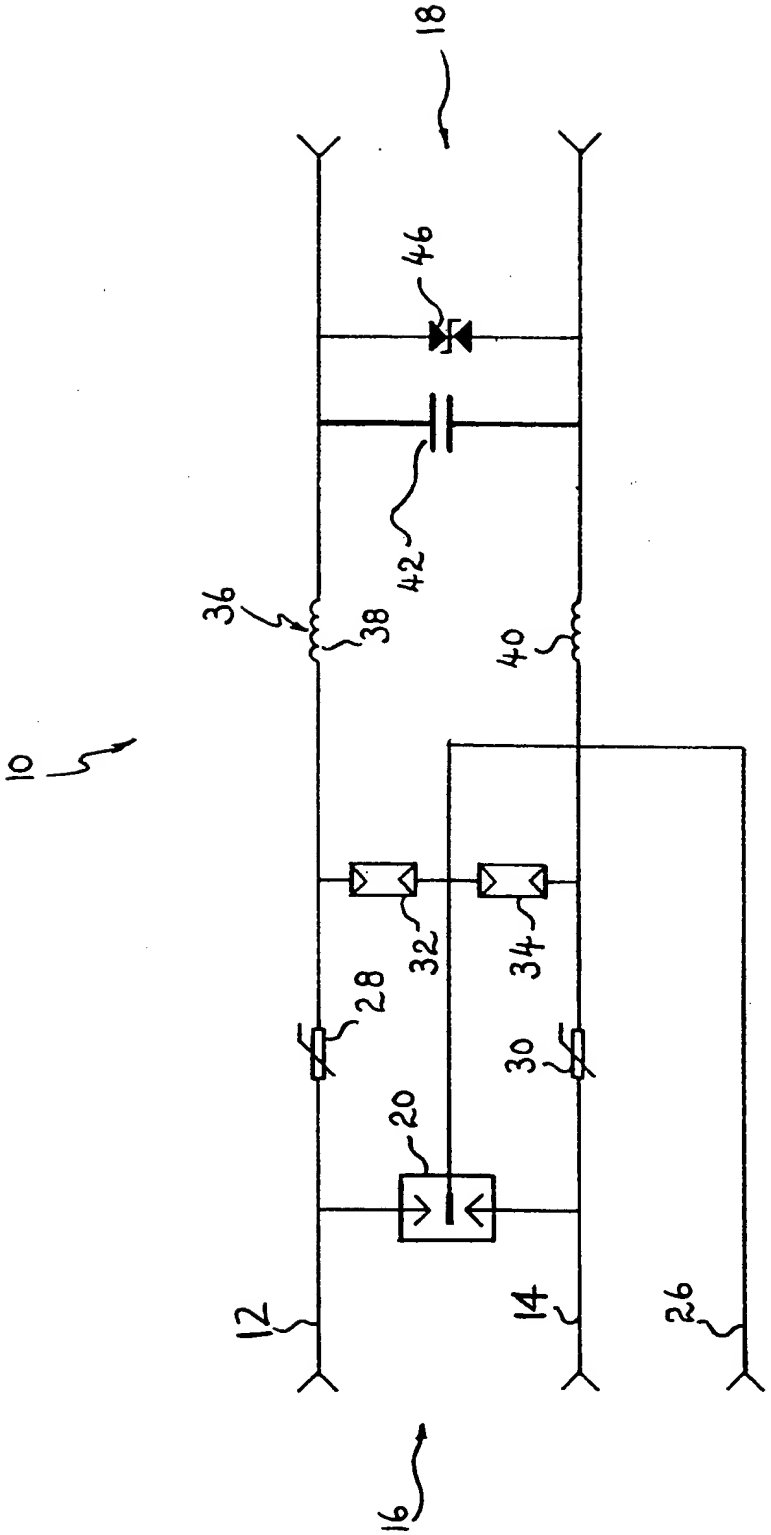

Fig 1

INTERNATIONAL SEARCH REPORT

International Application No.
PCT/AU 98/00405

A. CLASSIFICATION OF SUBJECT MATTER

Int Cl[6]: H02H 9/04; H04B 15/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC: H02H 9/04, 9/02, 3/20; H04B 15/00; H03H 5/IC; H03H 7/IC

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WPAT : (Power()line # or Communicat:() Line#) AND (Transient# or surg: or Limit: or Distort: or Jitter: : or Noise) AND Filter:
JAPIO : as above

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4023071 A (FUSSELL) 10 May 1977 Column 2 line 11-column 3 line 30	1-10
A	US 4342013 A (KALLMAN) 27 July 1982 Figure 1; abstract	1-10
A	GB 2164813 A (SHARP KABUSHIKI KAISHA) 26 March 1986 Figure 1; abstract	1-10

[X] Further documents are listed in the continuation of Box C

[X] See patent family annex

* Special categories of cited documents:

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Date of the actual completion of the international search
3 July 1998

Date of mailing of the international search report
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INTERNATIONAL SEARCH REPORT

International Application No.
PCT/AU 98/00405

C (Continuation) **DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4616286 A (BREECE) 7 October 1986 Column 2 line 5-line 54	1-10
A	US 4628394 A (CROSBY et al) 9 December 1986 Figure 1; column 1 line 24-column 2 line 23	1-10
A	US 5500629 A (MEYER) 19 March 1996 Figure 7; column 7 lines 46-column 8 line 22	1-10

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International Application No.
PCT/AU 98/00405

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
US	4023071	NONE					
US	4342013	NONE					
GB	2164813	DE	3533489	JP	61077409	US	4760231
US	4616286	NONE					
US	4628394	US	4584622				
US	5500629	CA	2170784	DE	19608219	GB	2299892
		JP	8321420				

END OF ANNEX

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